

**State of California  
AIR RESOURCES BOARD**

**Research Screening Committee Meeting  
Cal/EPA Headquarters Building  
1001 I Street  
Conference Room 550  
Sacramento, California 95814  
(916) 445-0753**

**July 20, 2007  
9:00 a.m.**

**ADVANCE AGENDA**

**Request for Proposals**

1. "Development of a California-Specific Intermodal Freight Transport Model," RFP No. 07-314, \$200,000

The objective of this research is to develop a California-specific intermodal freight transport model to describe the movement of goods into California's ports and through California's highway and rail systems. Specifically, this project is intended to develop a Geographic Information System (GIS) compatible model system for 1) quantifying emissions, including criteria pollutants and greenhouse gases, from land-side and water-side freight transport alternatives, 2) evaluating tradeoffs among emissions, cost, and travel time for moving freight between two points, and 3) identifying a multi-criteria optimization framework by analyzing preferred routing and tradeoffs under both existing and alternate transportation scenarios.

2. "Developing a California Inventory for Ozone Depleting Substance and Hydrofluorocarbon Banks and Emissions from Foams," RFP No. 07-312, \$250,000

The objective of the project will be to quantify the populations of foams in California by the types of blowing agents utilized [ozone depleting substances (ODS), hydrofluorocarbons (HFC), hydrocarbons, carbon dioxide (CO<sub>2</sub>), others] and a detailed accounting of the amount of foam stock by product category (e.g., small appliance refrigeration) including both the associated banks and annual emissions. Specifically, for each application, the emissions rates (during foam production, installation, and lifetime), turnover rates, end-of-life disposal emissions, sector growth rates, refrigerant substitution rates, and banks will be generated. The timescales associated with emissions from foams (during lifetimes and after disposal) will be examined, as well as the effect of disposal method (shredding, landfilling, incineration) on greenhouse gas (GHG) emissions.

Mitigation strategies will be examined in terms of costs and benefits as well as life cycle climate performance (LCCP), examples of which include the following: emission reductions associated with foam production, installation, and lifetimes; low-global warming potential (GWP) blowing agents and not-in-kind (NIK) alternatives to high-GWP foam applications; and end-of-life recovery and thermal destruction of high-GWP foams. Emissions scenarios based on BAU as well as those incorporating various control strategies will be examined in the year 2020 to estimate possible CO<sub>2</sub>-equivalent (CO<sub>2</sub>E) GHG reductions and the associated costs, based on LCCP.

The deliverables of the proposed project include a detailed bottom-up inventory for high-GWP GHG foam-blowing agents in California reflecting the existing stock as well as current and projected emissions for 2020. The contractor will be required to propose a methodology for generating the inventory that could include data gathering from trade associations as well as surveying the sectors that employ high-GWP GHG foams in various applications.

3. "Developing a California Inventory for Selected Applications of Perfluorocarbons, Sulfur Hexafluoride, Hydrofluorocarbons, Nitrogen Trifluoride, Hydrofluoroethers, and Ozone Depleting Substances," RFP No. 07-313, \$200,000

The objectives of the project will be to quantify emission rates (during production and use), application growth rates, chemical substitution rates, banks, and end-of-life disposal emissions (if applicable) for each high global warming potential (GWP) greenhouse gas (GHG) in each application.

Mitigation strategies, such as emissions reductions associated with chemical substitutes, alternatives, and technology or process changes will be examined in terms of costs and benefits as well as life cycle climate performance (LCCP). The costs and benefits of recovery and/or destruction of high-GWP GHGs in each application will be estimated.

Emissions scenarios based on BAU as well as those incorporating various control strategies will be examined in the year 2020 to estimate possible CO<sub>2</sub>-equivalent (CO<sub>2</sub>E) GHG reductions and the associated costs, based on LCCP.

The deliverables of the proposed project include a detailed bottom-up inventory for high-GWP GHGs in California by use category, including associated equipment numbers where applicable. The contractor will be required to propose a methodology for generating the inventory that could include data gathering from trade associations as well as surveying the sectors that employ high-GWP GHGs in various applications.

4. "The California Climate Change Industry: the Current Market and Prospect for Growth in the Global Economy," RFP No. 07-315, \$200,000

The objective of this study is to define the climate change industry and characterize its current status and assess its relative importance to the California economy today and in

the future. The contractor should also identify market drivers that can help in further development and growth of the industry in California. The information obtained from this study will assist ARB and other State agencies that are in charge of implementing climate change initiatives in assessing the positive impacts of their regulatory actions.

### **Sole Source Proposals**

5. "On-Road Motor Vehicle Emissions Measurements Including Ammonia, Sulfur Dioxide, and Nitrogen Dioxide," University of Denver, \$90,042, Proposal No. 2632-257

The University of Denver proposes to use its Fuel Efficiency Automobile Test (FEAT) instrument, commonly called the remote sensing device (RSD), to provide hitherto unavailable data regarding on-road emissions of ammonia ( $\text{NH}_3$ ), nitrogen dioxide ( $\text{NO}_2$ ), and sulfur dioxide ( $\text{SO}_2$ ). All three are important particle precursors, and  $\text{NO}_2$  is a direct and immediate ozone-forming compound, but they have not previously been measured in California. This project will also obtain on-road emissions data for carbon monoxide (CO), volatile organic compounds (VOC), and nitric oxide (NO). Measurements will be made from approximately 60,000 vehicles at three locations in California: the South Coast Air area, the San Joaquin Valley, and San Francisco Bay area. The results of this study are expected to provide useful information on current mobile-source emissions of  $\text{NH}_3$ ,  $\text{NO}_2$ , and  $\text{SO}_2$ , and assess how these emissions vary among three major regions of California.

6. "Improved Geospatial Forecasting of Commercial Marine Vessels," University of Delaware, \$47,954, Proposal No. 2635-257

In May 2005, international regulations, developed by the International Maritime Organization (IMO), came into effect to limit sulfur oxide emissions from ship exhaust. Because the regulations allow for the designation of sulfur oxide ( $\text{SO}_x$ ) Emission Control Areas (SECA) with more stringent emission restrictions, several agencies have since been investigating the development of possible SECA designations. Since 2004, the Air Resources Board (ARB) has worked with the United States Environmental Protection Agency (U.S. EPA), Environment Canada, the Mexican government, and other states to assess environment impacts of Commercial Marine Vessel (CMV) emissions. A recently completed ARB-funded SECA project provided a baseline (2002) inventory of CMV emissions and future inventories (2010 and 2020) at a regional scale, which are critical in modeling environmental impacts relevant to potential SECA designation. The proposed project will supplement the completed project by developing a set of vessel-specific spatial and temporal inventories for the same base and future years. The types of vessels to be analyzed include containerships, bulk carriers, tankers, general cargo vessels, roll-on/roll-off vessels, and refrigerated cargo ships. The air pollutants of interest are particulate matter (PM), sulfur oxides ( $\text{SO}_2$  or  $\text{SO}_x$ ), nitrogen oxides ( $\text{NO}_x$ ), carbon dioxide ( $\text{CO}_2$ ), carbon monoxide (CO), and hydrocarbons (HC). The results of this project are intended to support efforts by ARB, federal, and international agencies, to quantify and evaluate potential air pollution and climate impacts from shipping, and to

investigate the development of an application to the IMO for a SECA on both the west and east coasts of North America, including coastal California.

### **Interagency Proposals**

7. "Cardiopulmonary Health Effects: Toxicity of Semi-volatile and Non-volatile Components of Ultrafine PM," University of California, Irvine, \$501,484, Proposal No. 2633-257

Epidemiological and animal studies have shown an association between near-roadway exposure to particulate matter and adverse health effects. This study will address the question of whether adverse effects are due to specific classes of reactive organic compounds on the particles. Ultrafine particles will be concentrated and heated to remove the semi-volatile organic compounds that may be responsible for the adverse health effects. Mice with elevated risk of coronary artery disease will be exposed to particles at a site near a roadway with or without semi-volatile organics. If successful, this project could improve the understanding of the mechanism of toxic action of freshly emitted combustion particles and identify fractions of ultrafine particles causally related to health effects. This information will also aid regulators and planners in developing air quality regulations to better protect the health of California residents.

8. "In-vehicle Air Pollution Exposure Measurement and Modeling for Pregnant Women in the National Children's Study," University of California, Irvine, \$500,000, Proposal No. 2636-257

In-vehicle exposures to vehicle-related pollutants are frequently high, due to a vehicle's proximity to relatively undiluted emissions from other vehicles, the typically rapid air exchange rate inside vehicles, and the average 95 minutes per day spent in the in-vehicle microenvironment. In-vehicle pollutant concentrations of ultrafine particles (UFP) and volatile organic compounds (VOCs) have been found to be up to 10 times higher than ambient levels. Nonsmoking residents of Los Angeles (LA) can receive up to 50% of their daily UFP and black carbon (BC) exposure from their time spent in vehicles. Furthermore, commuting times have been predicted to double by 2020 due to population growth in the LA area, making it even more important to develop models to be used to estimate the impact of increased vehicle-related exposures. These models can then be incorporated into health effects models to determine the effect of vehicle related pollution on people's health.

The proposed study will collect in-vehicle air pollution data in Southern California, in addition to developing and validating in-vehicle exposure models. The investigators postulate that the models could be used in proposed studies to incorporate estimated in-vehicle exposures into health effects models for investigations such as the National Children's Study (NCS) a cohort of pregnant women in Southern California. The modeling approach is designed for possible use in other epidemiology studies as well, such as the Environmental Pregnancy Outcomes Study. The results from the current project is considered essential to obtain the separate funding needed to conduct the

health studies that link with these models. The findings of this study will provide information that can be used in CARB's evaluations of air quality and mobile source emission measurements and controls.

9. "Is Disparity in Asthma Among Californians due to Higher Pollutant Exposures, Greater Susceptibility, or Both?" University of California, Los Angeles, \$299,794, Proposal No. 2637-257

According to the 2003 California Health Interview Survey (CHIS 2003), 4.5 million Californians suffer from asthma and an additional 3.4 million Californians suffer from asthma-like breathing problems. The elderly, children, racial/ethnic minorities, women, and low-income Californians suffer disproportionately from asthma or asthma-like symptoms. A better understanding of the health effects that both low socioeconomic status (SES) and air pollution may exert independently or in combinations is needed to support and focus efforts to protect these potentially vulnerable populations. The objectives of this study are to characterize air pollution exposures at CHIS 2003 respondent residence locations. The study will determine whether the disproportionate burden of asthma or asthma-like symptoms among low SES individuals is associated with greater pollutant exposures, greater vulnerabilities or both. The proposed research will provide crucial information on whether current Federal or State air quality standards sufficiently protect vulnerable sub-populations.

10. "Assessing Near-Field Exposures from Distributed Residential Wood Smoke Combustion Sources," California Polytechnic State University, San Luis Obispo, \$320,286, Proposal No. 2634-257

In some areas of the State wood is burned for heat and is a significant contributor to winter Particulate Matter PM<sub>2.5</sub> levels, which often exceed the State and Federal standards and expose people to significant health risk. The objectives of this proposal are to: determine the spatial variability of wood smoke within a wood burning community; assess how local sources of wood smoke impact individuals' exposures; and estimate the contribution of nearby outdoor sources to indoor wood smoke levels. The investigators would perform air monitoring and modeling studies of wood smoke within a small community Fresno, a city with substantial wood burning. Information from this study would be useful to local air district planners and to others who develop control plans to reduce smoke levels and to protect the health and welfare of community residents. The results would inform the Air Resources Board (ARB) regarding the importance of wood smoke exposures relative to other PM sources and the possible need for new control measures. It would also provide a demonstration of a new community wood smoke measurement method and a new metric to express source-receptor relationships within communities.

11. "Using Lead and Strontium Isotopes to Assess Asian Aerosol Impacts in Urban and Interior California," University of California, Berkeley, \$48,983, Proposal No. 2639-257

The global-scale transport of airborne pollutants increases the local "background" pollutant burden in California, reducing the amount of local emissions that can be permitted and still attain air quality standards. Asian dust and combustion products are known to be regularly transported to California. Growth of Asian emissions will increase this background burden and may complicate attainment of air quality standards. High altitude monitoring data shows that Asian particles dominate the mean composition of the lower free troposphere over California, while sparse data from a few coastal sites show much smaller sea-level impacts. The burden of Asian pollutants at low altitudes inland sites is expected to be greater than at the coast, but there are no published data on this impact; these data are needed to assess current and future Asian background impacts. This has been used in the past to track the sources of lead pollution on local and regional scales. This project will exploit source-linked lead and strontium isotopic fingerprints measured in aerosol samples from Asia and rural California to assess Asian contributions of both fugitive dust and combustion products in low altitude urban and agricultural regions of California.

12. "Evaluation of Efficiency Activities in the Industrial Sector Undertaken in Response to Greenhouse Gas Emission Reduction Targets," University of California Berkeley/Lawrence Berkeley National Laboratory, \$95,000, Proposal No. 2638-257

The California Global Warming Solutions Act of 2006 calls for reducing greenhouse gas (GHG) emissions to 1990 levels by 2020. This aggressive goal will require emission reductions in all sectors, including the industrial sector. The goal of this research is to identify the characteristics of successful industrial sector GHG emissions reduction and energy efficiency programs in other countries in order to provide a summary of lessons learned and make recommendations for specific industrial sector program designs that could be implemented in California. Research will identify top energy consuming industries in California, then examine national-level programs in other countries that address five key California industrial sectors. Program design elements, the level of industry participation, and the realized energy savings will be reported. Investigators will survey facility managers to identify the top barriers faced when initiating the program and to learn about specific GHG emission reduction technologies. Information from the project will assist the Air Resources Board (ARB) in designing programs and policies to achieve energy and carbon dioxide (CO<sub>2</sub>) savings from top emitting California industries. Increased industrial energy efficiency and reduced GHG emissions can lead to cost savings, improved competitiveness, and reduced emissions of criteria pollutants.

13. "Retail Climate Change Mitigation: Life-Cycle Emission and Energy Efficiency Labels and Standards," University of California, Berkeley, \$135,000, Proposal No. 2640-257

The Air Resources Board (ARB) is at the forefront of reducing greenhouse gas (GHG) emissions from a wide range of sources. Estimates are that up to 80 percent of the

annual GHG “footprint” of the average U.S. consumer is attributable to the purchase, use, and disposal of retail products. The emissions associated with their manufacture and disposal may represent an untapped source of potential GHG emissions reductions. The proposed contractor has developed a methodology that may lead to the creation of total life-cycle GHG emission labels and standards for retail products which could provide manufactures with significant incentives for minimizing life-cycle GHG emissions from retail products sold in California. The proposed research will provide ARB with a comprehensive emission input-output life cycle analysis model that characterizes the embedded GHG emissions of all retail products sold in California, an estimate of life cycle GHG emissions reductions attainable for 20-30 retail products, an analysis of the emissions impact labeling would have on these 20-30 products, and a roadmap for the implementation of a retail product labeling and standards programs in California. The results of this work will provide ARB with the first step -- the analytical framework to assess the potential impact of labeling and product standards for retail products on GHG emission reductions in California.

### **Draft Final Reports**

14. “Monitoring and Modeling of Ultrafine Particles and Black Carbon at the Los Angeles International Airport,” University of California, Los Angeles, \$117,986, Contract No. 04-325

Exposure to ambient particulate matter (PM) poses serious health concerns in California, with fine (PM<sub>2.5</sub>) and ultra-fine (UFP) particles of special concern. Prior studies indicated that aircraft emissions from major airports could have significant impacts on neighboring communities, but were not able to quantify the extent of nearby PM exposures, nor the extent of health concern. This is because the methods used could not assess UFP levels, and could not distinguish aircraft emissions from other combustion sources such as traffic arteries and nearby industrial sources. This study used near-real-time monitoring equipment at the Los Angeles International Airport (LAX) and in the nearby community to determine levels of UFP, black carbon, and PM<sub>2.5</sub> emitted from aircraft. Aircraft activity at LAX was found to contribute pollutants to the downwind community.

15. “Documentation of the SAPRC-07 Chemical Mechanism and Updated Ozone Reactivity Scales” University of California, Riverside, \$166,132, Contract No. 03-318

The gas phase chemical reaction mechanism is a critical component in air quality simulation models. A completely updated version of the Statewide Air Pollution Research Center (SAPRC)-99 chemical mechanism, designated SAPRC-07, has been developed and is documented in this report. The SAPRC-99 mechanism was considered a state-of-the-science in 1999, and has been widely used in many applications. For example, the mechanism has been implemented into urban airshed models for the development of the State Implementation Plan (SIP) for ozone in California. This new mechanism includes a complete update of recent laboratory and environmental chamber data, improved representations for many types of volatile

organic compounds (VOCs), a capability of representing chlorine chemistry, and a new method to represent peroxy reactions for modeling formation of particulate matter (PM). SAPRC-07 was evaluated against the results of more than 2400 environmental chamber experiments carried out in 11 different environmental chambers for over 120 types of VOCs. In general, the evaluation results were satisfactory for most types of VOCs but some discrepancies were observed for some VOC mixture experiments. The updated mechanism was then used to derive an update to the maximum incremental reactivity (MIR) for approximately 1100 different VOCs. The updated mechanism will be implemented into a regional air quality model for evaluation and validation and is expected to result in an improved capability for predictions of secondary air pollutants such as ozone, secondary PM, and air toxics.

16. "The Collection and the Development of Exhaust Speciation Profiles from Modern Commercial Jet Aircraft Engines," University of Missouri, \$259,960, Contract No. 04-344

The objective of this project was to develop total organic gases (TOG) and particulate matter (PM) speciation profiles for emissions from engines used in newer Boeing 737-type commercial aircraft burning Jet A turbine fuel. This was accomplished by collecting samples of the exhaust from the engines of parked aircraft while they were operated over a wide range of power settings. The samples were analyzed either in real time or in subsequent laboratory work to determine chemical speciation of the particulate and gaseous matter, and the physical characteristics and morphology of the particulate matter. Airport traffic is expanding and yet information is scarce on the exhaust speciation profiles of either TOG or PM from modern commercial jet aircraft using current fuels. Such data are needed for planning, air quality assessment, and environmental impact review efforts.

17. "Nighttime Chemistry: Observations of  $\text{NO}_3$  and  $\text{N}_2\text{O}_5$ ," University of California, Berkeley, \$122,778, Contract No. 04-335

Ammonium nitrate is a key component of the composite particulate matter of aerodynamic size 2.5 micrometers and less ( $\text{PM}_{2.5}$ ). Nighttime chemical reactions between nitrates (from ozone and nitrogen dioxide ( $\text{NO}_2$ ) photochemistry) and nitrogen dioxide (from direct emissions and NO photochemistry) form dinitrogen pentoxide ( $\text{N}_2\text{O}_5$ ) and further reactions produce nitric acid. Nitric acid combined with ammonia to form ammonium nitrate that essentially removes emitted nitrogen oxides ( $\text{NO}_x$  meaning NO and  $\text{NO}_2$ ) species from the troposphere. However,  $\text{N}_2\text{O}_5$  may also dissociate forming  $\text{NO}_2$ , and  $\text{NO}_2$  would continue to participate in nighttime aerosol reactions. At the start of this project, there were no current field measurements for nighttime  $\text{N}_2\text{O}_5$  and nitric acid ( $\text{HNO}_3$ ) that would reliably support California's  $\text{PM}_{2.5}$  simulations. These simulations are the regulatory tools for compliance demonstration required for  $\text{PM}_{2.5}$  and other PM California State implementation plans (SIP). As part of this project University of California Berkeley (UCB) staff upgraded the prototype laser induced fluorescence (LIF) instrument that has successfully measured ambient concentrations of nitric acid and  $\text{N}_2\text{O}_5$  to reach 15 to 25 parts per trillion volume (pptV) sensitivity required



for a robust simulation validation data set. UCB staff conducted two biweekly measurement campaigns at Blodgett Forest station and at a farm near Bakersfield. The data produced as a result of this project can serve as inputs and as validation tools for PM simulations. These measurements improve Air Resources Board (ARB's) PM modeling efforts and thus improve SIPs based on PM modeling.